connection 122. A known crimping tool (not shown) is used to crimp the connection 122 onto the wire 38 and wire loop 124 for connecting the chain 118 to the wire 38.

The chain 118 is then introduced into the tubing 34. However, because the tubing 34 is not, in many cases, located directly over the well, an assist in such cases must be provided for the chain 118. An assist found to be useful is provided by a push tool 126 of the type shown in FIGS. 14–17. The push tool 126 frictionally engages the outer surface of the chain 118 and pushes it into the tubing 34 a sufficient distance until gravitational forces begin acting on the chain 118 and cause it to fall of its own weight. The push tool 126 should be able to push at least 70–100 ft. of chain into the tubing 34.

As shown in FIGS. 12–15, the push tool 126 includes a pair of gripping jaws, such as those provided by a pair of VICE-GRIPS®, on which a pair of guides 128 and 130 are mounted. The guides 128 and 130 and guide extensions 128A and 130A (FIG. 17) form a hollow opening 132 through which the chain 118 can pass, when the guides are closed by moving the guide 128 in the direction of arrow 129 as shown in FIG. 17. A small electric motor 124 is connected to one of the guide extensions 130A, which drives a wheel 134 formed of rubber or other compressible elastomer. As the chain 118 passes between the drive wheel 134 and an adjacent idler wheel 135, rotation of the drive wheel 134 in the direction of the arrow 138 pushes the chain 118 in the direction of the arrows 136.

A guide tube 140 positioned between the guide extensions 128A and 130A guides the chain 118 into the tubing 34. After the chain 118 is pushed into the tubing 34 a sufficient distance, gravity will begin operating on the chain 118 so that it falls of its own weight. The wire line truck 62 is moved in the direction of the arrow 74 (FIG. 5) to adjust the helical pitch of the tubing 34 for maintaining an acceptable tension in the conductor 36 below its break strength resulting from the frictional contact between the outer surface of the conductor 36 and the inner surface of the tubing 34.

The rate of descent of the chain 118 and conductor 36 (preferably at about 200 ft./min.) is governed by a gear motor 102 connected to the reel 100, shown in FIG. 10, which controls the rate of rotation of the reel 100. Thus, if the pitch of the helix in the tubing is maintained constant, the tension in the conductor (e.g., the weight of the chain 118 and conductor 36 being supported in the tubing by the conductor) will be maintained at a constant level during the entire insertion process. The gear motor 102 regulates the speed of descent and the helical shape of the tubing 34 supports the weight of the conductor 36.

For an insulated electrical conductor wire of the type described above, the break strength is about 60 lb., which is less than the combined weight of the conductor 36 and the chain 118 after the conductor 36 is inserted to predetermined depth. However, by regulating the pitch of the tube 34, the conductor 36 is able to support its own weight and will not break as it falls by gravity through the tube 34.

As shown in FIG. 10, as the conductor is unwound from the reel 100, it moves in the direction of arrows 108, over idler pulleys 110, 112 and pulley 106, through alignment rollers 114, and into the tubing 34 which is mounted in the holding fixture 91. A tension indicating device in the form of a scale 104 can be connected to the conductor 36 through the pulley 106 for maintaining a continuous reading of the tension load in the conductor 36, which is an indication of the weight being carried by the conductor 36. It was found that a weight of about 3–12 lbs. carried in a conductor having a break strength of about 60 lbs., provided a workable range.

After the conductor 36 is completely inserted into the tubing 34, the tubing 34 is then re-connected to the reel 60 and the wire-in-a-tube is removed from the well and wound on the reel 60. Thus, a conductive wire-line assembly is formed in a way that eliminates the need to place the conductor in coiled tubing as it is formed, which has the advantages described above.

While a preferred embodiment for practicing the invention has been described, it should be understood that there are many modifications, variations and improvements that can be made that are within the spirit and scope of the invention, and that all such modifications, variations and improvements are contemplated as being covered by the appended claims.

I claim:

1. A method for inserting at least one conductor into an elongated length of metal coiled tubing, comprising the steps of:

(a) placing the coiled tubing in a substantially vertical passageway;

(b) inserting said conductor into the tubing, the leading end of the conductor including an elongated weight connected to the conductor, which weight is heavy enough to straighten the conductor enough to fall through the tubing, the weight having essentially no stiffness so that it is flexible enough to move through bends or irregularities in the tubing;

(c) allowing the conductor and weight to fall by gravity through the tubing, which has a sufficient helical pitch providing a hold-up force due to friction for preventing the conductor from breaking, until the desired length of conductor is inserted in the tubing; and

(d) removing the tubing with the conductor inside the tubing from the passageway and winding the tubing on a reel.

2. The method of claim 1, wherein the step of inserting a conductor includes inserting one or more insulated electrical conductor wires.

3. The method of claim 1, wherein the step of inserting a conductor includes inserting one or more optical fibers.

4. The method of claim 1, wherein the step of inserting a conductor includes inserting a combination of insulated conductor wires and optical fibers.

5. The method of claim 1, wherein the step of placing the coiled tubing includes the step of inserting at least a 1,000 ft. length of coiled tubing into a subterranean well bore.

6. The method of claim 5, wherein the step of placing the coiled tubing includes the step of inserting coiled tubing that has an outer diameter of ⅛"–½".

7. The method of claim 5, and further including the steps of disconnecting the tubing from a reel mounted on a truck and connecting the coiled tubing to the truck.

8. The method of claim 1, wherein the step of inserting the conductor includes the step of connecting a weight having an elongated segmented structure to the leading end of the conductor and inserting the weight into the tubing.

9. The method of claim 8, wherein the weight is formed of a chain having interconnected links.

10. The method of claim 9, wherein the chain is roll-formed and has a minimum bend radius.

11. The method of claim 10, wherein the chain has minimum bend radius of about ¼"–24".

12. The method of claim 1, wherein the step of allowing the conductor and weight to fall by gravity includes the step of regulating the tension in the tubing so as to regulate the pitch of the helical shape of the tubing so that the frictional

hold-up force between the outer surface of the conductor and the inner surface of the tubing is sufficient for the conductor to support its own weight in the tubing.

13. The method of claim 12, wherein the step of regulating the tension in the tubing includes the step of moving a truck to which the coiled tubing is connected.

14. The method of claim 1, wherein the step of allowing the conductor and weight to fall by gravity further includes the step of controlling the speed the conductor is allowed to fall.

15. The method of claim 14, wherein the step of controlling the speed includes the steps of operatively connecting a reduction gear motor to the reel from which the conductor unwinds and operating the motor at a predetermined speed.

16. The method of claim 1, wherein the step of inserting the conductor into the tubing includes the step of pushing the weight into the tubing until the weight can fall vertically through the tubing.

17. The method claim 16, wherein the step of pushing the weight includes the step of pushing the weight around at least one 90° bend in the tubing.

18. The method of claim 16, wherein the step of pushing includes the step of engaging the weight between a pair of rollers, and rotating at least one of the rollers for moving the weight through the tubing.

19. A method for inserting at least one insulated electrical conductor wire into a length of small-diameter coiled tubing extending substantially vertically in a subterranean well, said tubing having an inner diameter less than about two-times the diameter of the conductor wire, comprising the steps of:

(a) connecting a weight to the leading end of the conductor wire, said weight being formed of a segmented structure having essentially no stiffness and being heavy enough to maintain the conductor straight enough to fall by gravity through the tubing;

(b) inserting the weight into the tubing and allowing the weight and conductor to fall by gravity through the tubing; and

(c) maintaining a helical pitch in the tubing sufficient to impart a frictional hold-up force between the outer surface of the conductor and the inner surface of the tubing for preventing the conductor from breaking due to its own weight.

20. The method of claim 19, wherein the step of connecting a weight includes connecting a weight formed of a chain having interconnected links.

21. The method of claim 20, wherein the step on connecting a weight includes connecting a roll-formed chain with a minimum bend radius.

22. The method of claim 21, wherein the step of connecting a weight includes connecting a roll-formed chain with a minimum bend radius of about ¼"–24".

23. The method of claim 19, wherein the step of maintaining a helical pitch includes the step of regulating the tension in the tubing.

24. The method of claim 23, wherein the step of regulating the tension includes the step of moving a truck to which the coiled tubing is connected.

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